Math-in-CTE Lesson Plan Template

Lesson Title: The effects of CS on RPMs		Lesson # M02
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Occupational Area: Machine Tool Technology		
CTE Concepts CS (cutting speeds)		
Math Concepts: Calculations		
Lesson Objective:	Show how cutting speeds affects the RPM setting while machining on a lathe	
Supplies Needed:	Speeds and Feed chart 47-1	

THE "7 ELEMENTS"	TEACHER NOTES (and answer key)
1. Introduce the CTE lesson.	
We must first have an understanding that there are many math concepts that must be first taught and understood before anyone can begin to operate a metal lathe safely. Today's lesson will focus on how CS affects RPM.	
Today's lesson will be how Cutting Speed (CS) affects the initial RPM setting on the lathe. The formula that you will be using is RPM = CS x 4/Diameter. This difference is extremely important in setup as well as in the final operation of a machine.	Show table 47-1, Speeds and feed chart.
	Show student running metal lathe.
There are a number of factors that must be considered when determining the correct cutting speed. Material used in the cutting tool itself, the material that is being cut, and rigidity of the work piece, just to name a few. Inappropriate cutting speeds can also cause tool burnout.	The words in red are vocabulary words for this lesson that are covered previous to this lesson so students are prepared for them and can recognize the key words.

2. Assess students' math awareness as it relates to the CTE lesson. **In the past you have learned how to interpret the charts on a metal lathe to acquire the information necessary to produce your part, using the safety quiz hand out sheet could you give me the number correlating to spindle speeds? Feed and Speeds?** **Can anyone explain what CS actually is?** **Having already completed a couple of projects to date, can anyone tell me where they would go to find the information required to begin calculating the RPM for a project?** **What other information do you need to know so you can calculate RPM? Does material identification matter to your ability to do your math equations?**	Show Jet Gh114w-3 safety quiz. Cutting speed is the distance the work moves past the tool, expressed in feet per minute. The students should be able to go and retrieve the information from the book on table 47 - 1, at this point they are ready to continue. They should also be able to recognize the importance of a rough cut feed rate vs. a finish cut feed rate. They should also have the ability to recognize the basic differences in materials so they can choose the correct cutting speed.
3. Work through the math example *embedded* in the CTE lesson. **The math formula for calculating RPM is CS x 4/D where RPM's = Revolutions per minute.** **CS = Cutting Speed,** **D = Diameter of work in inches** **Calculate the RPM for a 3.000-inch diameter tool steel shaft using a HSS Tool Bit using a Rough Cut feed rate.** **Keep in mind that the Feed Rates shown in Table 47 – 1, Speeds and Feed, show the minimum and maximum rates that you should consider. Depending on machine condition, material, and other factors, they may have to be increased or decreased throughout their range until optimum cutting conditions are obtained.**	Show Table 47 – 1, Lathe Cutting Speeds. Rough Cut = .010 to .020 RPM = 90 x 4 / 3 RPM = 120 Items in blue are feed rates that are determined from the same chart, Table 47 - 1. These feed rates are based on what you are looking for in the end appearance of your part after you take a cut. For extra remedial work if necessary, go to Table 47 - 1, page 1. Show Table 47 - 1, page 1.

4. Work through *related, contextual* math-in-CTE examples. Now let's look at some other samples of how Cutting Speeds affect the RPM by using different diameters as well as different shaft material. Look at Table 47 – 1, Lathe Cutting Speed, page 2, and solve the following problems, showing all of your work. Table 47 – 1, page 2, now adds the additional task of calculating the RPM for different kinds of materials as well as asking for a specific finish after the cut. Problem 1. Calculate the RPM for a 4.000-inch diameter aluminum shaft using a rough cut feed rate with a HSS Tool Bit. Problem 2. Calculate the RPM and Machine Time for a 3.000-inch diameter bronze shaft. You will have to face off the 3.000-inch bronze shaft on one end, and then you will be required to turn the O.D. to a new diameter of 2.1875 inches by 2.1875 inches long. Your maximum depth of cut to use is .030 with a finish cut rate of .006. Use a HSS Tool Bit. Using the following formulas: Time = Distance / Rate Where Distance = Length of cut Rate = Feed x RPM RPM = CS x 4/D	Show Table 47 – 1, page 2, at this point students are given the appropriate amount of time to complete the work sheet. **Problem 1** RPM = 200 x 4 / 4 RPM = 200 **Problem 2.** RPM = CS x 4/D RPM = 100 x 4 / 3 RPM = 133 **Face cut** Time = 3 / (.006 x 133) Time = 3 / 0.798 Time = 3.759 min **Turning time** Time = 2.1875 / (.006 x 133) Time = 2.1875 / 0.798 Time = 2.741 min per cut on length **Amount of material to remove** **Major Diameter – Minor Diameter** 3.000 – 2.1875 = 0.8125 **Number of cuts required to get to size** 0.8125 / .030 (depth of cut) = 27.083 cuts **Total turn time = Number of Cuts x Time per cut** 76.748 mins. = 28 (cuts) x 2.741(cut time in mins.) **Total Machine Time = face time + turn time** **Total Machine Time = 3.795 min. + 76.748 mins. = 80.543 mins.**

5. Work through *traditional math* examples. In each problem, show how the formula **Distance = Rate x Time** can be used to solve the problem. Please be sure to show all of your work. Problem 1. We all know Mr. Milton enjoys fishing and hunting but did you know he also loves to search for antique bottles. While attending a conference at Sunday River Resort, he was told there was an antique shop down the road a bit. After half an hour of driving at an average speed of 40 miles per hour, he pulls into a quaint little antique shop to begin his shopping experience. How far was the shop from the resort? Distance = Rate x Time	Distance = Rate x Time = 40(miles/hour) x (1/2) hour = 20 miles
Problem 2. Van Buren's favorite machine tool teacher is also an avid hunter. During target practice, Mr. Milton shot a target 450 yards away. If the bullet travels 2900 fps (Feet Per Second), how much time did it take to hit the target? Express your answer to the nearest thousandths of a second. This problem will also require you to make a conversion from yards to feet.	Distance = Rate x Time 450 yards = 2900 fps (Feet Per Second) x Time 450 (3 feet) = 2900 fps x Time 1350 ft / 2900 fps = Time 0.466 seconds = Time

6. Students demonstrate their understanding. For the remaining time left in this lesson you will be given a print of a project. Upon receiving your print, you will need to complete a Job Planning Sheet for that particular part and submit it to me. You will have to identify the material that is required and follow through with your Job Planning Sheet and machine your part as required on your print. You will be able to assess your work when you finish the project part by following the Evaluation Sheet on the back of your print. After you have completed your evaluation sheet, you will have to complete your formal inspection of the part as well.	Show Job Planning Sheet. The Job Planning Sheet has been covered in previous lesson plans. Show a print that a first semester machinist might work on. Show the assessment page on the back of the print.
7. Formal assessment. **Your formal assessment will be done following the rubric designed for the task at hand. The rubric follows closely with the one that is printed on the back of each of the prints that you will receive. Your part will be taken to the inspection table where it will be inspected with the appropriate measuring tools. I will check the tolerances with you so that you can see just where, if any, there is a problem.**	The part will be taken to the inspection table where the teacher will inspect it with the student observing. It will have to meet the tolerances listed on the print and if not listed, they will have to meet the house standards. Each student is aware of these house standards and has a copy of these standards in their folders.

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